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AN ANALYSIS OF THE FACTORS CONTRIBUTING TO AN ACCEPTABLE  
BENEFICIAL SUGGESTION

A Thesis

Submitted to the Faculty

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H91

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The help, criticism, and encouragement of Dr. Robert W. Field is gratefully acknowledged. Through his guidance, many problems of this thesis were circumvented.

The cooperation and assistance of the officers and staff of the U. S. Naval Ordnance Plant, Indianapolis; the U. S. Naval Ordnance Plant, Forest Park; and the U. S. Naval Ammunition Depot, Crane, is also acknowledged. By generously allowing the use of their records and reports, the pursuit of this problem was made possible.

1. The first part of the report discusses the general situation of the country and the progress of the work in the various departments. It also mentions the results of the recent elections and the state of the finances.

2. The second part of the report deals with the internal affairs of the country, including the administration of justice, the education system, and the state of the economy. It also mentions the progress of the various public works and the state of the military.

3. The third part of the report discusses the external affairs of the country, including the relations with the neighboring countries and the progress of the diplomatic work. It also mentions the state of the foreign trade and the progress of the various international organizations.

4. The fourth part of the report deals with the social and cultural life of the country, including the state of the various social services, the progress of the education system, and the state of the various cultural institutions.

5. The fifth part of the report discusses the progress of the various public works and the state of the military. It also mentions the results of the recent elections and the state of the finances.



## ABSTRACT

A beneficial suggestion is a constructive idea designed to result in an improvement or economy in the operation of a business or activity, submitted in writing by an employee, for the purpose of having it considered for an appropriate award.

From past experience, it has been determined that the quantity of acceptable beneficial suggestions averages from 25 to 30 percent. Some believe that this is a reasonable level of success; others try to by-pass the problem and, by various means of publicity, increase the total number of suggestions submitted. While the percentage of acceptable suggestions will remain about the same, the absolute number of acceptable ones increases.

A fundamental axiom of beneficial suggestions systems is that the employee on the job is in the best position to recognize the need for improvements. Since the average worker is not always qualified for this task, it would be desirable to give him some facts known to contribute to the development of an acceptable beneficial suggestion.

Thus the aim or object of this paper is to identify, single out, evaluate and place in rank order those fundamental components that actually contribute to an acceptable beneficial suggestion.

Since the writer is a Naval Officer, it was decided to limit the scope of this study to three Naval Shore Establishments in the vicinity of Lafayette, Indiana. The three plants selected were the U. S. Naval Ordnance Plant, Indianapolis, Indiana; the U. S. Naval Ordnance Plant, Forest Park, Illinois; and the U. S. Naval Ammunition Depot, Crane, Indiana. These plants are alike in that they employ approximately 1600

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civilians and engage in light manufacture. The latter differs from the former two in that it has the added feature of large ammunition storage facilities.

The problem, the determination of the factors contributing to the development of an acceptable beneficial suggestion, was attacked by the internal consistency method. Past files of beneficial suggestions submitted between the years, 1946 and 1950, were divided into two groups: "acceptable" and "not acceptable." These were analyzed in the light of twenty-four carefully selected factors.

After the data had been gathered from the plants and the frequency of each factor determined, analysis was carried out by the use of:

- a. Percentage
- b. D-values
- c. Correlation
- d. Multiple correlation

By the use of percentages, those factors appearing less than 5 percent of the time in winning suggestions were immediately discarded. D-values and zero order coefficients of correlation were used to place the remaining factors in rank order.

In the case of the Naval Ordnance Plant, Indianapolis, those factors that contributed the most to the development of an acceptable suggestion were:

- |   |    |
|---|----|
| 1. Is there a measurable monetary saving?           | 5* |
| 2. Has an operation been eliminated or made easier? | 5  |
| 3. Have inspections been eliminated?                | 1  |
| 4. Has quality been improved?                       | 3  |
| 5. Has a movement been eliminated or made easier?   | 5  |

\* Frequency of selection as a contributing factor in the plants studied.

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6. Has material been conserved?	3
7. Has waste been reduced?	3
8. Have operations been combined?	2
9. Has a delay been eliminated?	3
10. Has machine time been reduced?	2
11. Have working conditions been improved?	3
12. Has morale been boosted?	3
13. Have accident hazards been reduced?	3

Multiple correlation was employed to determine what selected combination of factors would result in the largest correlation with the criterion. The three factors, selected from the previous list, that resulted in the largest multiple coefficient were:

Selected Items	Multiple Coefficient
Saving, monetary . . . . .	.84
Saving plus work conditions . . . . .	.94
Saving plus work conditions plus fewer delays . .	.95

When the study of the beneficial suggestions at the Naval Ordnance Plant, Forest Park, was completed, a slightly different group of factors associated themselves with the winning suggestions:

1. Is there a measurable monetary saving?	3
2. Has a tool been suggested?	2
3. Has an operation been eliminated or made easier?	3
4. Has quality been improved?	3
5. Has a jig or fixture been suggested?	3
6. Has a movement been eliminated or made easier?	3

1. The first part of the report is devoted to a general survey of the situation in the country.

2. The second part of the report is devoted to a detailed analysis of the economic situation.

3. The third part of the report is devoted to a detailed analysis of the social situation.

4. The fourth part of the report is devoted to a detailed analysis of the political situation.

5. The fifth part of the report is devoted to a detailed analysis of the cultural situation.

6. The sixth part of the report is devoted to a detailed analysis of the environmental situation.

7. The seventh part of the report is devoted to a detailed analysis of the international situation.

8. The eighth part of the report is devoted to a detailed analysis of the future prospects.

9. The ninth part of the report is devoted to a detailed analysis of the conclusions.

10. The tenth part of the report is devoted to a detailed analysis of the recommendations.

11. The eleventh part of the report is devoted to a detailed analysis of the implementation.

12. The twelfth part of the report is devoted to a detailed analysis of the monitoring.

13. The thirteenth part of the report is devoted to a detailed analysis of the evaluation.

14. The fourteenth part of the report is devoted to a detailed analysis of the summary.

15. The fifteenth part of the report is devoted to a detailed analysis of the annexes.

16. The sixteenth part of the report is devoted to a detailed analysis of the bibliography.

17. The seventeenth part of the report is devoted to a detailed analysis of the index.

18. The eighteenth part of the report is devoted to a detailed analysis of the list of abbreviations.

19. The nineteenth part of the report is devoted to a detailed analysis of the list of symbols.

20. The twentieth part of the report is devoted to a detailed analysis of the list of tables.

21. The twenty-first part of the report is devoted to a detailed analysis of the list of figures.

22. The twenty-second part of the report is devoted to a detailed analysis of the list of maps.

23. The twenty-third part of the report is devoted to a detailed analysis of the list of photographs.

24. The twenty-fourth part of the report is devoted to a detailed analysis of the list of films.

25. The twenty-fifth part of the report is devoted to a detailed analysis of the list of sound recordings.

26. The twenty-sixth part of the report is devoted to a detailed analysis of the list of publications.

27. The twenty-seventh part of the report is devoted to a detailed analysis of the list of documents.

28. The twenty-eighth part of the report is devoted to a detailed analysis of the list of sources.

7. Has machine time been reduced?	2
8. Have accident hazards been reduced?	3
9. Has waste been reduced?	3
10. Has material been conserved?	3
11. Has a delay been eliminated or reduced?	3
12. Has housekeeping been improved?	2
13. Have working conditions been improved?	3
14. Has morale been boosted?	3

A similar list resulted from the MAD Crane data after the original array of factors was reduced and then ranked by D-value and/or coefficient of correlation:

1. Is there a measurable monetary saving?	3
2. Has a tool been suggested?	2
3. Has quality been improved?	3
4. Has an operation been eliminated or made easier?	3
5. Have operations been combined?	2
6. Has a movement been eliminated or made easier?	3
7. Has waste been reduced?	3
8. Have health hazards been reduced?	1
9. Have accident hazards been reduced?	3
10. Has a jig or fixture been suggested?	3
11. Has material been conserved?	3
12. Has a delay been eliminated or reduced?	3
13. Has housekeeping been improved?	2
14. Has morale been boosted?	3
15. Have working conditions been improved?	3
16. Is Government property better protected?	1

1. The first

2. The second

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25. The twenty-fifth

26. The twenty-sixth

27. The twenty-seventh



In the case of the last two activities, the technique of multiple correlation was not pursued. The number of beneficial suggestions available was not sufficient to result in inter-correlation coefficients reliable enough to produce a meaningful multiple coefficient.

Final analysis of the results indicated that in all cases the single important factor in a beneficial suggestion was a measurable monetary saving. This factor did not stand alone; it was always associated with another factor such as elimination of operations or employment of a new tool, jig, or fixture.

Human relations factors brought up the end of the list. Now this is to be expected for several reasons. First, the average working man has had little experience in solving problems of this type. Second, the factors pertaining to human relations, by definition, encompass workers as a group and not as individuals. The average suggestion submitted along these lines benefited a few rather than many employees.

However, when the Wherry-Doolittle technique was applied to determine what combination of factors resulted in the highest multiple coefficient of correlation, it was observed that while a measurable saving was still first, some human relations factor was second.

In conclusion it can be said that it is possible to measure and place in rank order those factors that contribute to a winning beneficial suggestion.

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## AN ANALYSIS OF THE FACTORS CONTRIBUTING TO AN ACCEPTABLE BENEFICIAL SUGGESTION

### INTRODUCTION

A beneficial suggestion is a constructive idea designed to result in an improvement or economy in the operation of a business or activity, submitted in writing by an employee for the purpose of having it considered for an appropriate award.

The United States Navy, like many civilian firms, uses a beneficial suggestion program to save money and improve employee morale. This is not new to the Navy. As early as 1918, the first Navy Beneficial Suggestion Program was authorized.<sup>1</sup> On 4 August 1919, Franklin Delano Roosevelt, the Acting Secretary of the Navy, issued a circular letter to naval activities outlining the rules for a Beneficial Suggestion Program.

Unfortunately this program did not provide anything like the desired quantity of suggestions. This is borne out by the record. The files from 1919 to 1932 indicate that only 280 awards were made at the Department level for employee suggestions accepted during that thirteen-year period.<sup>2</sup>

This plan continued until the outbreak of World War II. It then became obvious that to better prosecute the war effort, every available bit of manpower and material must be put to use. The Beneficial Suggestion Program offered a partial solution. It is sufficient to say here that the system was streamlined and functioned satisfactorily during the war years. Shortly after World War II, Executive Order 9817 set forth

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<sup>1</sup> An act of Congress approved 1 July 1918.

<sup>2</sup> Rear Admiral P. B. Hibecker, Chief of the Office of Industrial Relations, address before the Washington Regional Conference of the National Association of Suggestion Systems, Washington, D. C., 21 May 1948.



the present regulations governing the awards to Federal employees for meritorious suggestions and for exceptional or meritorious service.<sup>3</sup>

The United States Navy has come a long way since the act of Congress on 1 July 1918. On 25 October 1949, the Department of the Navy was awarded a plaque by the National Association of Suggestion Systems for being the government establishment to show the greatest increase in participation by its civilian employees in the Beneficial Suggestion Program during the year, 1948.<sup>4</sup> During the period specified, Navy employees submitted 38,673 suggestions as compared with 28,029 the year before. Compare this to the 280 suggestions submitted between the years, 1919 and 1932. On reviewing the magnitude of the individual awards, the picture is just as impressive. Of the highest awards reported paid, the Navy ranked third with an individual award of \$10,000.<sup>5</sup>

However, these are past accomplishments; one must continuously look forward. It is well to recall the words of Francis P. Mathews, who said: "In this day of shrinking appropriations, it is more than ever important that we obtain for the country the utmost in defense for every Navy dollar expended." With this in mind, an effort will be made to develop procedures and techniques to make the Navy's program more effective.

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<sup>3</sup> Act of 2 August 1946 (Public Law 600, 79th Congress) Section 14.

<sup>4</sup> SecNav - OIR 223:as Circular letter dated 10 November 1949.

<sup>5</sup> Nibecker, op. cit.

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### THE PROBLEM

When one compares the functioning of the Navy Department's suggestion system with that of private industry, it is noted that the overall comparison is quite favorable (Table 1). While it is not the purpose of this paper to account for any minor differences appearing in Table 1, it is observed that both civilian companies and the Navy have had a proportional increase in the number of beneficial suggestions submitted.

In the second item, percent adopted, the Navy tends to lead civilian firms. However, this is offset to some extent by a slight decline in those adopted between the years, 1947 and 1949.

The third item, average award, is slightly greater for the Navy; yet the rate of shrinkage from 1947 to 1949 indicates that they will soon be nearly equal.

Although the data is not complete for the last two items, it appears that the Navy system compares quite favorably with industry. As a point of explanation, it must be remembered that civilian firms have nothing comparable to a maximum on-the-spot award. This is a limitation imposed by the Naval Civilian Personnel Instructions Twenty-five, which sets forth the rules for operating a Beneficial Suggestion Program. The sum of \$251.00 represents an average maximum of 41 percent of the companies surveyed.

In view of Table 1 and the observation that moneys spent for defense must be spent wisely, it would seem that a technique or method to assist in increasing the volume of acceptable beneficial suggestions would be highly desirable. However, this is a controversial subject. Some authors feel that 25 to 30 percent acceptable suggestions is adequate.

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Table 1

A Comparison of the Navy Department's Beneficial Suggestion Program  
with Recent Survey by the National Association of Suggestion Systems

	NASS Survey <sup>6</sup>		U. S. Navy <sup>7</sup>	
	1947	1949	1947	1949 <sup>8</sup>
Suggestions Submitted per 100 Workers	14.2	19.5	10.6	14.2
Percent Adopted	21.0%	25.7%	29.7%	31.5%
Average Award	\$21.50	\$17.50	\$32.00	\$24.00
Maximum on the Spot Award	9	\$251.00	\$275.00	\$275.00
Maximum Award on Survey	9	\$12,104	9	\$10,000

<sup>6</sup> Charles M. Otis-James L. McVittie, Presentation of 1949 NASS Survey of Suggestion System Operation, Oct. 24, 1949.

<sup>7</sup> Navy Beneficial Suggestion Program, Annual Operating Statistics for 1944 - 1948.

<sup>8</sup> Fiscal 1949.

<sup>9</sup> Not Available.





For example, Seimwerth<sup>10</sup> says: "If an employee can win an award for one out of every three or four suggestions submitted, he is, in my opinion, performing excellently." Presumably, Seimwerth does not mean that every employee can win an award, but of all the suggestions submitted by an employee, one out of every three or four will win. The fact that there is no universal agreement on this point is demonstrated by efforts expended - at least intermittently - to increase the number of acceptable suggestions.

Two standard methods for obtaining additional acceptable suggestions are: (a) to put on a concerted advertising or publicity campaign, or (b) to point out specific problems that require a solution. The former has the disadvantage that it is a temporary stimulant. While the total volume of suggestions received and the accompanying paper work is sure to increase, the percentage of acceptable suggestions remains about the same. Even though the latter approach usually obtains better results, it becomes increasingly difficult to locate worthwhile problems. The writer's opinion, which has been borne out in conversation with members of several beneficial suggestion committees, is that the heart of a suggestion is in locating the actual problem; the solution can be accomplished by standard techniques.

Thus, we return to the fundamental concept of a beneficial suggestion; the employee on the job is in the best position to recognize the need for improvements closest to him. Unfortunately this does not make the employee qualified for the task. It would appear that a worker could be assisted immeasurably if he was presented with a few factors known to contribute to an acceptable beneficial suggestion.

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<sup>10</sup> Herman W. Seimwerth, Getting Results from Suggestion Plans, McGraw-Hill Co., Inc., 1948, p. 145.

For example, the first of these is the fact that the  
out of the world, and the second is the fact that the  
people of the world are not all of the same race, and  
the third is the fact that the people of the world are  
not all of the same color, and the fourth is the fact  
no more than the fact that the people of the world are  
at least as different as the people of the world are  
the same as the people of the world are, and the fifth  
on (a) is the fact that the people of the world are  
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and the tenth is the fact that the people of the world  
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center, and the twentieth is the fact that  
to the world, and the twenty-first is the fact that  
the world, and the twenty-second is the fact that

Thus it can be said that the aim or object of this paper is to identify, single out, evaluate and place in rank order those fundamental components that actually contribute to an acceptable beneficial suggestion.

1. The first part of the report is a general introduction.

2. The second part of the report is a detailed description of the

3. The third part of the report is a discussion of the results.

## PROCEDURE

The writer, being a Naval Officer, is primarily interested in the functioning of the Naval Shore Establishment. Thus it was decided to limit the scope of this study to three naval activities in the vicinity of Lafayette, Indiana. The three plants selected were the U. S. Naval Ordnance Plant, Indianapolis, Indiana; the U. S. Naval Ordnance Plant, Forest Park, Illinois; and the U. S. Naval Ammunition Depot, Crane, Indiana. In the future, these three activities will be referred to by their short titles: NOPI, NOP-PP, and MAD Crane respectively.

In any testing procedure, it is necessary to set up a suitable criterion. In some instances this might be quite difficult. However, from the statement of the problem, it seems to go without saying that the criterion is to be the final dichotomy of any submitted beneficial suggestion, acceptance or rejection.

This problem is to be attacked by a technique known as the internal consistency method. This consists of measuring available beneficial suggestions and correlating the results with the criterion - winning. Thus the first step is to compile a battery of tests and test them for reliability and validity.

Because all beneficial suggestions at the above plants are judged in accordance with Naval Civilian Personnel Instructions Twenty-five (NCPI 25), this publication offered a positive starting point. Paragraph 4-1 of NCPI 25 lists the general types of suggestions desired. This list of suggestions has been reproduced in Table 2. To this table has been added four columns which reflect those items considered most applicable by NOPI, NOP-PP, MAD Crane and NCF (U. S. Naval Gun Factory, Washington, D. C.) to their particular activity. It should be noted here



Table 2

Beneficial Suggestion Topics Considered Most Applicable by Several Naval Activities

		NCPI 25	NOPI	NAD Crane	NOP-FP	NCF
Improving	Methods of Operation . . . . .	X	X	X	X	X
	Quality of Product . . . . .	X	X	X	X	X
	Working Conditions . . . . .	X	X		X	X
	Housekeeping . . . . .	X				
	Tools and Machinery . . . . .	X			X	X
	Protection of Govt. Property . .	X				
	Employee Morale . . . . .	X	X	X		
	Utilization of Manpower . . . .	X			X	X
Increasing	Production . . . . .	X	X	X	X	X
	Safety . . . . .	X	X	X	X	X
Combining	Operations . . . . .	X				
Devising	New Tools and Machinery . . . .	X	X			
	New Methods . . . . .	X			X	
Reducing	Cost . . . . .	X	X	X	X	X
	Waste . . . . .	X	X	X	X	X
	Fire Hazards . . . . .	X			X	
	Health Hazards . . . . .	X			X	
	Accident Hazards . . . . .	X			X	
Eliminating	Duplication . . . . .	X	X	X		
	Unnecessary Work . . . . .	X	X	X	X	X
	Breakage . . . . .	X	X	X		
Conserving	Material . . . . .	X	X	X	X	X





that any omission does not mean that this topic has been considered unimportant. This table represents topics within the scope of the average employee, after giving due consideration to the nature of the activity, type of work accomplished and the abilities of the worker.

On reviewing Table 2, two points are immediately obvious:

1. Each organization has indicated its preferences by selecting a group of subjects considered most applicable to its situation.
2. While many of these items are quite specific, several are quite broad and tend to overlap.

In view of these preferences and the tendency to overlap, it seemed desirable to use a battery of tests with a breakdown so fine-grained that the tests would be fundamental and applicable to any set of circumstances. Table 3, which contains 24 tests used to evaluate all beneficial suggestions studied, is composed predominantly of tests suggested by Mundel<sup>11</sup> and NCPI 25. These tests, listed in Table 3, are defined as follows:

1. Has an operation been eliminated or made easier?

An operation is all the work carried out at essentially one place, or in the vernacular, from tote-box to tote-box.

2. Has a movement been eliminated or made easier?

A movement has many connotations and runs the gamut from

- (a) amount of body used, (b) foot pedals, (c) bimanualness,
- (d) eye-hand coordination, (e) handling requirements, to
- (f) weights lifted or forces necessary to operate equipment.

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<sup>11</sup> M. E. Mundel, Systematic Motion and Time Study, Prentice-Hall, 1947, pp. 64-92.

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Table 3

## Twenty-four Tests Used to Evaluate Beneficial Suggestions

1. Has an operation been eliminated or made easier?
  2. Has a movement been eliminated or made easier?
  3. Has a delay been eliminated or reduced?
  4. Have countings been eliminated?
  5. Have inspections been eliminated?
  6. Have operations been combined?
  7. Have movements been combined?
  8. Have delays been combined?
  9. Has machine time been reduced?
  10. Is more work accomplished during the machine cycle?
  11. In group work, does one man hold up the work?
  12. Have fire hazards been reduced?
  13. Have health hazards been reduced?
  14. Have accident hazards been reduced?
  15. Have working conditions been improved?
  16. Has waste been reduced?
  17. Has material been conserved?
  18. Has quality been improved?
  19. Has morale been boosted?
  20. Has housekeeping been improved?
  21. Is Government property better protected?
  22. Is there a measurable monetary saving?
  - \* 23. Has a tool been suggested?
  - \* 24. Has a jig or fixture been suggested?
- \* Not included in study made at MOPI

THE HISTORY OF THE UNITED STATES

1. The first settlers of the United States were the Pilgrims who came to the New World in 1620.
2. The Pilgrims were a group of English Puritans who sought religious freedom.
3. They established the Plymouth colony in Massachusetts.
4. The Pilgrims faced many hardships, including lack of food and shelter.
5. Despite these challenges, they survived and thrived.
6. The Pilgrims' story is a testament to the power of faith and perseverance.
7. Their legacy lives on in the United States today.
8. The Pilgrims' story is a reminder of the importance of freedom and the pursuit of the American dream.
9. The Pilgrims' story is a source of inspiration for many Americans.
10. The Pilgrims' story is a part of the fabric of American history.
11. The Pilgrims' story is a story of hope and possibility.
12. The Pilgrims' story is a story of courage and determination.
13. The Pilgrims' story is a story of faith and devotion.
14. The Pilgrims' story is a story of love and compassion.
15. The Pilgrims' story is a story of unity and harmony.
16. The Pilgrims' story is a story of peace and justice.
17. The Pilgrims' story is a story of freedom and independence.
18. The Pilgrims' story is a story of the United States.
19. The Pilgrims' story is a story of the American people.
20. The Pilgrims' story is a story of the United States of America.
21. The Pilgrims' story is a story of the American dream.
22. The Pilgrims' story is a story of the American spirit.
23. The Pilgrims' story is a story of the American way of life.
24. The Pilgrims' story is a story of the American identity.
25. The Pilgrims' story is a story of the American future.

3. Has a delay been eliminated or reduced?

The only delays to be considered are those which are unavoidable or inherent in the job. An example would be operator idleness while waiting on a machine to complete its cycle.

4. Having countings been eliminated?

Here countings are to include either verification against a standard (inspection purposes) or the determination of the quantity present (inventory).

5. Have inspections been eliminated?

Besides the usual connotation of inspection, statistical methods are to be included.

6. Have operations been combined?

Operation means the same as in Number 1. Combining of operations might be facilitated by changing (a) work order, (b) using different equipment, or (c) changing layout.

7. Have movements been combined?

Movement is to mean the same as in Number 2. The combining of movements could be brought about by (a) changing the order of work, (b) changing the layout, or (c) changing the quantity handled at one time.

8. Have delays been combined?

Delay means the same as in Number 3.

9. Has machine time been reduced?

The meaning of this is obvious.

10. Is more work accomplished during the machine cycle?

Another way of stating this would be to consider a change in the man-machine phase relationship. This would permit the worker to accomplish more hand work during running time.

1. What is the purpose of this document?

The purpose of this document is to provide a comprehensive overview of the project's objectives, scope, and timeline. It serves as a guide for all stakeholders involved in the project, ensuring that everyone is aligned and working towards the same goals.

2. What are the key objectives of the project?

The key objectives of the project are to develop a new product line, expand into new markets, and improve operational efficiency. These objectives are supported by a series of strategic initiatives and tactical actions.

3. What is the project's scope and timeline?

The project's scope includes the development of three new product lines, the launch of two new markets, and the implementation of a new operational framework. The timeline for the project is as follows:

4. What are the key milestones and deliverables?

The key milestones and deliverables for the project are as follows:

- Completion of the initial project plan by [Date]
- Launch of the first product line by [Date]
- Completion of the market expansion strategy by [Date]
- Implementation of the new operational framework by [Date]

5. What are the risks and challenges associated with the project?

The risks and challenges associated with the project include:

- Resource constraints: Limited budget and personnel may impact the project's progress.
- Market competition: Increased competition may affect the project's success.
- Operational complexity: The implementation of a new operational framework may be challenging.

6. What are the next steps and action items?

The next steps and action items for the project are as follows:

7. What is the project's budget and funding source?

The project's budget and funding source are as follows:

8. What is the project's communication plan?

The project's communication plan includes regular meetings with stakeholders, progress reports, and a dedicated communication channel for project-related issues.

11. In group work, does one man hold up the work?

When work performed during the cycle is unevenly distributed, the man with the most work to accomplish controls the cycle time.

12. Have fire hazards been reduced?

This is self-explanatory.

13. Have health hazards been reduced?

This too is self-explanatory.

14. Have accident hazards been reduced?

This is to include accidents to personnel only. Accidents involving material, waste and Government property are included under other headings.

15. Have working conditions been improved?

Working conditions are the physical surroundings of the job. Some evidence indicates that improved working conditions will improve morale.<sup>12</sup> Thus, in gathering data, whenever this factor received a tally mark, Item 19 also received a tally mark.

16. Has waste been reduced?

Waste, as used here, is synonymous with spoilage. It is the material rendered unusable due to inadequacies of equipment, lack of sufficient employee skill and characteristics inherent in the job.

17. Has material been conserved?

Material conservation is the salvaging or reclaiming of materials having only scrap value, by a better use of pre-

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<sup>12</sup> J. Tiffin, Industrial Psychology, Second Edition, Prentice-Hall, Inc., N.Y., pp. 475-476.

[illegible]

1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2671, 2672, 2673, 2674, 2675, 2676, 2677, 2678, 2679, 26



sently employed material and the employment of substitutes.

18. Has quality been improved?

This item includes appearance, improved functioning and longer life.

19. Has morale been improved?

Morale is used in its collective sense here. It is the group state of mind or attitude due to the adoption of a particular suggestion. It is not to be construed with the individual employee's attitude due to submitting a prize-winning suggestion.

20. Has housekeeping been improved?

This does not include any of the cleaning and preventive maintenance details that are covered by maintenance personnel on a predetermined schedule.

21. Is Government property better protected?

Besides the usual types of loss and damage, also included are improved techniques for maintaining buildings and grounds.

22. Is there a measurable monetary savings?

This item is self-explanatory; its answer, obviously, is a function of several variables.

23. Has a tool been suggested?

Tool is used in a limited sense here. It includes any device that is capable of working a material into a desired shape and measuring devices; jigs and fixtures are excluded.

24. Has a jig or fixture been suggested?

A jig holds or is held by the workpiece while guiding a cutting tool. Fixtures only hold or locate the workpiece.

1. The first part of the document is a list of names and addresses of the members of the committee.

2. The second part of the document is a list of names and addresses of the members of the committee.

3. The third part of the document is a list of names and addresses of the members of the committee.

4. The fourth part of the document is a list of names and addresses of the members of the committee.

5. The fifth part of the document is a list of names and addresses of the members of the committee.

6. The sixth part of the document is a list of names and addresses of the members of the committee.

7. The seventh part of the document is a list of names and addresses of the members of the committee.

Since the score on any of the foregoing tests cannot be distributed in the usual continuum but by only a simple dichotomy, "Yes" or "No", these tests will be referred to in the future as factors.

While the actual gathering of the data was quite laborious, the procedure was simple. Each suggestion was read and analyzed in the light of all the supporting evidence. This usually consisted of the original suggestion, comments by the various departments on investigation forms, miscellaneous notes made by the recorder of the committee, and final disposition of the suggestion. As each factor appeared, a tally mark was recorded on a form much like Table 3.

For purposes of this study, the final disposition of a suggestion fell into one of two categories:

1. Accepted
  - a. Monetary award
  - b. Letter of commendation
2. Rejected
  - a. Unsuitable
  - b. Technicality

Since the purpose of this paper is to focus attention on the factors contributing to an acceptable suggestion and not on the magnitude of the award, suggestions that received monetary awards or letters of commendation were grouped together. However, all rejected suggestions were not considered to be in the same category. For example, due to the instructions for operating a beneficial suggestion program, NCPI 25, or any other set of rules for that matter, a few good ideas are rejected on a technicality alone. A typical situation would be where an idea was in use more than six months before being submitted. Thus, suggestions of this nature were not considered.

1. The first part of the report deals with the general situation of the country and the progress of the work during the year. It is divided into two main sections: the first section deals with the general situation and the second section deals with the progress of the work.

2. The second part of the report deals with the results of the work during the year. It is divided into three main sections: the first section deals with the results of the work in the field of research, the second section deals with the results of the work in the field of teaching, and the third section deals with the results of the work in the field of administration.

3. The third part of the report deals with the conclusions of the work during the year. It is divided into two main sections: the first section deals with the conclusions of the work in the field of research, and the second section deals with the conclusions of the work in the field of teaching and administration.

4. The fourth part of the report deals with the recommendations of the work during the year. It is divided into two main sections: the first section deals with the recommendations of the work in the field of research, and the second section deals with the recommendations of the work in the field of teaching and administration.

5. The fifth part of the report deals with the summary of the work during the year. It is divided into two main sections: the first section deals with the summary of the work in the field of research, and the second section deals with the summary of the work in the field of teaching and administration.

After the data had been gathered, it was analyzed by several techniques, each of which had to be tempered with a certain amount of judgment reflecting any unusual circumstances. Since it was desirable to reduce Table 3 to a shorter and more meaningful list as quickly as possible, the following methods were employed:

1. Percentage
2. D-value
3. Correlation
4. Multiple correlation

It was realized at the outset that some of the factors in the battery would appear infrequently in the final tally. Thus any factor that appeared less frequently than approximately 5 percent of the time in the acceptable breakdown was immediately deleted. This resulted in what will be referred to as an abridged list or table.

Another, and more elegant, method of determining the relationship between the factors and the criterion is to determine the D-value and the coefficient of correlation. While D-values and coefficients of correlation measure about the same thing, the ease of obtaining a D-value is offset by the fact that the zero order coefficient is a component that can be used in computing the coefficient of multiple correlation.

Numerous statistical techniques for estimating the validity of individual test items have been reported in the literature. Long and Sandiford<sup>13</sup> have a technique whose development they credit to Truman L. Kelley. The "Kelley technique" consists of the following steps:

1. Determine the percentage of successful responses to a given item by members of the "high" criterion group.

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<sup>13</sup> John A. Long and Peter Sandiford, "The Validation of Test Items," Bulletin No. 3, Department of Educational Research, Toronto: University of Toronto, 1935, pp. 16-50.

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2. Determine the percentage of successful responses to the item by members of the "low" criterion group.
3. Using the appropriate normal probability curve tables, find the standard score or z score value of the ordinate which subtends the percentage found in Step 1.
4. Find the corresponding value for the percentage found in Step 2.
5. Determine the discrimination value or validity index by subtracting the result obtained in Step 4 from the result obtained in Step 3.

This system involves a good deal of work if there are many test items. Lawshe has developed a nomograph<sup>14</sup>, Figure 1, which reduces the time necessary to estimate D-values or discrimination values which are suitably accurate. The nomograph is used by the following of the steps below:

1. Having determined the percentage of successful responses to a given item by members of the "accepted" criterion group, locate this value on the scale marked: "Percent of accepted group."
2. Having determined the percentage of successful responses to the item by members of the "rejected" criterion group, locate this value on the scale marked: "Percent of rejected group."
3. Lay a straight-edge across the page so that it will pass through these two points.

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<sup>14</sup> C. H. Lawshe, Jr., "A Nomograph for Estimating the Validity of Test Items," The Journal of Applied Psychology, Vol. XXVI, No. 6, pp. 846-849, December, 1942.

1. The first step in the process of the investigation is to identify the problem.
2. The second step is to gather information about the problem.
3. The third step is to analyze the information and determine the cause of the problem.
4. The fourth step is to develop a plan of action to solve the problem.
5. The fifth step is to implement the plan and monitor the results.
6. The sixth step is to evaluate the results and determine if the problem has been solved.
7. The seventh step is to document the results and share them with others.
8. The eighth step is to reflect on the process and learn from the experience.

The purpose of this investigation is to identify the cause of the problem and develop a plan of action to solve it. The investigation will be conducted in a systematic and organized manner. The results of the investigation will be documented and shared with others. The purpose of this investigation is to identify the cause of the problem and develop a plan of action to solve it.

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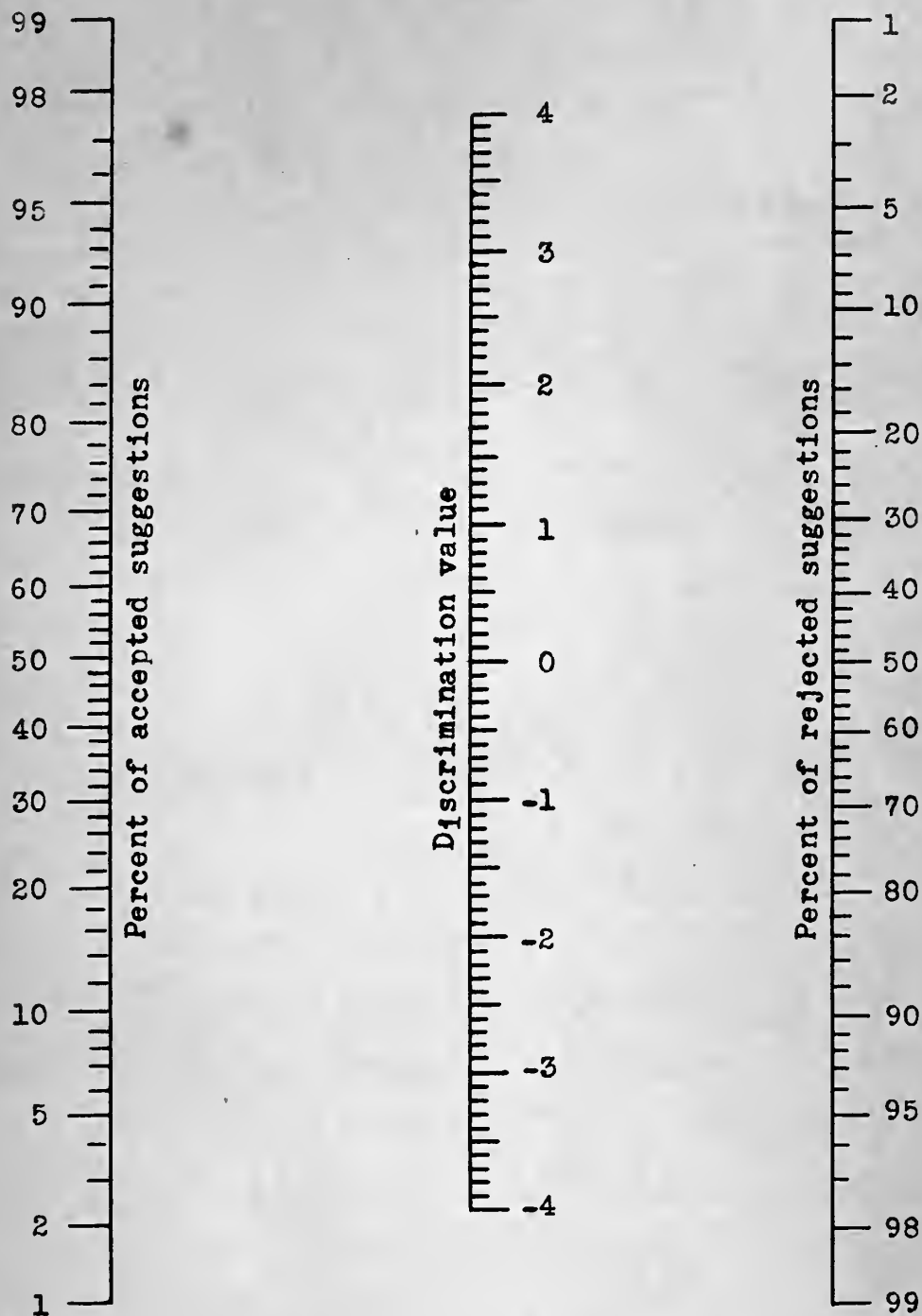


Fig. 1 A Nomograph for Estimating D-values by C. H. Lawshe

1. The first of these is the fact that the

present position of the world is such that

the only way to avoid a world war is to

maintain a balance of power between the

great powers of the world.

2. The second of these is the fact that the

present

position of the world is such that the

only way to avoid a world war is to

maintain a balance of power

between the great powers of the world.

3. The third of these is the fact that the

present position of the world is such that

the only way to avoid a world war is to

maintain

a balance of power between the great

powers of the world.

4. The fourth of these is the fact that the

present

position of the world is such that the

only way to avoid a world war is to

maintain a balance of power between the

great

powers of the world.

5. The fifth of these is the fact that the

present position of the world is such that

the only way to avoid a world war is to

maintain a balance of power

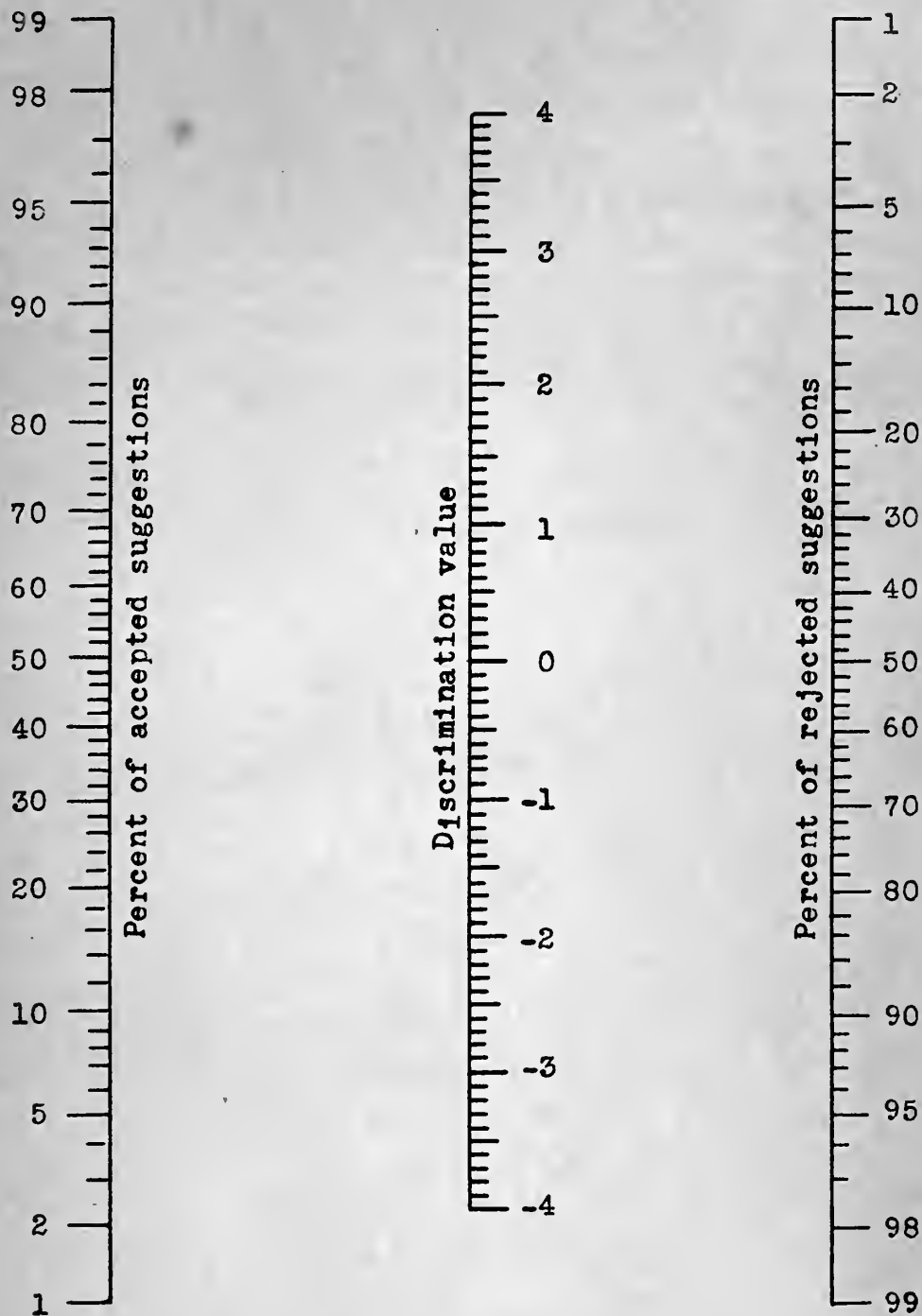


Fig. 1 A Nomograph for Estimating D-values by C. H. Lawshe



4. Read the D-value on the center scale at the point where the straight-edge intersects the vertical line.

For example, let us consider some of the NOPI data. Factor  $X_1$ , possessed by 72% of the accepted group and by 24% of the rejected group, would be assigned a D-value of 1.30. Another factor,  $X_{11}$ , possessed by 15% of the accepted group and by 11% of the rejected group, would have a D-value of 0.18.

Lawshe also suggests that due to the asymptotic nature of the normal curve, the nomograph should not be used for values smaller than 1% nor greater than 99%. In any case, the particular D-value will be on the conservative side.

Not infrequently one or both of the variables to be correlated are not continuously variable. One or both of the variables may be capable of only being classified into two or more distinct classes.<sup>15</sup> For example, if we wish to correlate the acceptance or rejection of a beneficial suggestion with the safety features therein, we are definitely limited to certain discrete categories. Since the data in both variables is forced into two categories, or naturally belong in two, the result is a fourfold classification or tetrachoric table. Let us take what we might call the responses to 391 beneficial suggestions to two factors from the NOPI data, in which the response had to be "Yes" or "No."

$X_0$  Did the suggestion win an award?

$X_{22}$  Is there a measurable monetary saving?

To use this data, the tetrachoric table is prepared as in Table 4.

However, using the data as it stands to compute the tetrachoric  $r$  is long and tedious. Guilford suggests that Table 4 be converted to a

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<sup>15</sup> J. B. Guilford, *Psychometric Methods*, McGraw-Hill Book Co., Inc., First Edition, 1936, pp. 310-332.



proportion bases as in Table 5 and the diagrams prepared by Thurstone<sup>16</sup> and his associates be used to solve for the tetrachoric  $r$ . Thus this was the technique selected to compute the coefficients of correlation to be used in the Wherry-Doolittle Test Selection Method.

The task of determining an acceptable beneficial suggestion by one of these factors alone is not as satisfactory as the combination of several factors into a battery. These factors, due to their very nature, measure one component of an entire suggestion. By referring to Table 6, page 25, it can be seen that each factor measures success to a certain degree. At the same time, these very same factors have a low or negative correlation with each other. This would lead one to assume that a selected combination of these factors would predict the chance of success better than one alone.

The determination of this group of factors is quite a long process by some methods. However, the standard Wherry-Doolittle Test Selection Method<sup>17</sup> solves the problem with a minimum of difficulty. This is a method for selecting a battery of tests, or factors in this case, that will give the maximum shrunken multiple correlation with the criterion; that is, the maximum multiple correlation after a correction has been made for chance error added by each factor. These factors are selected in the order of their contribution to the multiple. As a rule, the increase in the multiple becomes less and less while at the same time the chance error increases. A point is finally reached where more chance error is added than actual validity.

<sup>16</sup> Leone Chesire, Milton Saffir, L. L. Thurstone, Computing Diagrams for the Tetrachoric Correlation Coefficient, The University of Chicago, 1933.

<sup>17</sup> William H. Stead, C. L. Shartle and Associates, Occupational Counseling Techniques, American Book Co., 1940, pp. 245-250.

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## ANALYSIS OF RESULTS

On page 7, reference was made to the reliability of a test. To be reliable, a test must consistently measure some one aspect. In other words, repetitive use of a test on a particular subject must yield essentially the same results to have a high reliability. This is best expressed in terms of the coefficient of correlation between the scores of the same or equivalent tests. Now, in the particular situation being investigated, a unique condition exists. This is because the "Yes" or "No" responses to the applicability of the factors in question comes directly from a beneficial suggestion that does or does not have the trait. In a case like this, nothing but a high reliability could result. It is therefore felt by the writer that unless some caution is to be observed, one might construe a high validity, correlation with the criterion, as indicating better results than are actually possible.

Probably a better technique to be employed in evaluating the reliability would be in terms of two separate parties evaluating the same beneficial suggestion. After all, the problem is twofold -- one of getting the same facts and one of all the facts that are present. It must be realized that in reading past files that are more than three or four years old, no matter how carefully all evidence is weighed, certain subtle points discussed by the action committee never become recorded and are lost forever.

This leads to the readily observable fact that nearly 39 percent of the factors in Table 3, page 10, are so fine-grained that they passed through the sieve of evaluation. This is not a serious difficulty; enough factors did come through to indicate specific results. However, should any particular plant decide to make a study such as this, it is

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recommended that the tally sheet, discussed on page 14, be completed by the beneficial suggestion committee at the time of actual evaluation.

For all practical purposes, the discrimination value, used with a reasonable amount of judgment, is as satisfactory in this particular situation as some of the more elegant techniques of correlation. This is due primarily to the small number of suggestions studied. However, since this was the entire past record of NOPI and essentially all of MCP-PP and MAD Crane, little could be done to alter this situation.

The effect of this small "N" was particularly noticeable in the computation of the tetrachoric coefficient of correlation where certain factors appeared relatively infrequently. Thurstone<sup>15</sup> states:

In using the computing diagrams, it is sometimes found that two or three of the determinations can be made by using the central field of the diagram while one of the determinations must be made by using one of the corners of the diagram. Since the lines are there much closer, it is clear that such a determination is not so accurate as the others; and consequently it should be ignored. In these cases the coefficient should be taken as the average of the two or three determinations that can be made in the central region of the computing diagram.

In using the tetrachoric correlation coefficient, it must of course be realized that the probable error is much larger than the error of the product moment coefficient that would be obtained if the two variables had been recorded in a larger number of class intervals than the two which are used for the tetrachoric coefficient. The tetrachoric coefficient should not be computed at all if the division of either or both of the two distributions is near the tail.

Even with  $N = 391$  as in the case of NOPI, the infrequent appearance of a factor resulted in forcing the work down into the corner of the computing diagrams. While it is realized that more laborious methods of calculation would result in a coefficient more accurate from the stand-

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<sup>15</sup> Leone Chesire, Milton Saffir, L. L. Thurstone, Computing Diagrams for the Tetrachoric Correlation Coefficient, The University of Chicago, 1933.



point of arithmetic, unless one was certain with a high degree of confidence that the data were essentially accurate, such expenditures of energy would be unwarranted. Thus it is felt that while the magnitude of the values of correlation and multiple correlation might be open to some question, the writer believes that the final rank order is essentially correct. However, to avoid the illusion of accuracy which the data does not justify, the use of multiple correlation has been avoided for MCP-PP and MAD Crane.

1. The first part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that proper record-keeping is essential for the transparency and accountability of the organization. This section also outlines the various methods used to collect and analyze data, ensuring that the information is reliable and up-to-date.

2. The second part of the document focuses on the implementation of the proposed changes. It details the steps involved in the rollout process, from initial planning to final execution. This section also addresses potential challenges and provides strategies to overcome them, ensuring a smooth transition to the new system.

3. The third part of the document discusses the ongoing monitoring and evaluation of the project. It highlights the need for continuous communication and collaboration between all stakeholders involved. This section also provides a timeline for the project, indicating key milestones and deadlines.

4. The final part of the document provides a summary of the project's objectives and outcomes. It reiterates the importance of the project and the commitment of the organization to achieving its goals. This section also includes a list of references and a glossary of terms used throughout the document.

## U. S. Naval Ordnance Plant, Indianapolis

One of the first plants studied was the U. S. Naval Ordnance Plant, Indianapolis, which employs approximately 1,450 people. During the war years, NOPI was concerned primarily with the development and manufacture of the Norden bombsight and aircraft lead-computing sights.

As in the case of other military, as well as civilian, establishments, the end of the war with Japan brought many changes in the operation of the Indianapolis Ordnance Plant. Late in 1945, the station reverted to complete naval operation and was converted to accomplish the mission originally intended, i.e., a shore establishment for research in and engineering development of aviation ordnance fire control equipment; the manufacture of line maintenance spares; and the overhaul, modification and modernization of fire control instruments including radar attachments and accessories.

A study of 391 beneficial suggestions was made at NOPI, of which 130 were considered acceptable and 261 were rejected. These suggestions covered an interval of time from January 1946 to February 1950. A graphic portrayal of the NOPI data and its distribution are shown in Figure 2, page 50 in the Appendix.

Table 3, on page 10, has been broken down into two tables. The first, Table 6, includes all the factors that appeared more frequently than 5 percent of the time in the winning suggestions. The first column, headed Rank, lists the factors in order of both their D-value and correlation with the criterion. The second column, headed Factor Number, is the original factor order as found in Table 3. This column is retained throughout the discussion as a ready reference to the factors in their original arbitrary position and also as a numerical designation in any following mathematical computations.

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Table 6

Abridged Battery of Factors, Ranked by D-value, for NOPI

Rank	Factor Number	Factor	D-value	$r_t$
1	X <sub>22</sub>	Is there a measurable monetary saving? . . . . .	1.83	.84
2	X <sub>1</sub>	Has an operation been eliminated or made easier?	1.30	.66
3	X <sub>5</sub>	Have inspections been eliminated? . . . . .	1.04	.56
4	X <sub>18</sub>	Has quality been improved? . . . . .	1.00	.54
5	X <sub>2</sub>	Has a movement been eliminated or made easier? .	.90	.51
6	X <sub>17</sub>	Has material been conserved? . . . . .	.89	.50
7	X <sub>16</sub>	Has waste been reduced? . . . . .	.75	.41
8	X <sub>6</sub>	Have operations been combined? . . . . .	.70	.40
10	X <sub>3</sub>	Has a delay been eliminated? . . . . .	.63	.35
15	X <sub>9</sub>	Has machine time been reduced? . . . . .	.32	.20
16	X <sub>15</sub>	Have working conditions been improved? . . . . .	.28	.17
19	X <sub>19</sub>	Has morale been boosted? . . . . .	.23	.12
20	X <sub>14</sub>	Have accident hazards been reduced? . . . . .	.18	.10



As one would expect, the single outstanding factor that exerts the most influence on having a beneficial suggestion accepted is a measurable monetary saving. This factor never appears alone, but is always accompanied by one or more of the remaining factors. These factors divide themselves into three general categories:

1. Those pertaining to making a job easier.
2. Those that eliminate waste and enable better utilization of facilities.
3. Those human relations factors with intangible monetary benefits.

As a complement to Table 6, Table 7 lists the factors appearing infrequently (less than 5 percent of the time) among the accepted or winning suggestions. These factors readily divide themselves into two categories:

1. Those previously mentioned fine-grained factors that are present but not included in the evaluation by the suggestion committee because other more gross factors better lend themselves to evaluation.
2. Those factors that are suitable, but because of applicability and/or employee's background seldom receive consideration by an employer. A more complete discussion of this phase will be considered in the Conclusion.

On continuing the breakdown of the factors, Table 6 has been subdivided into Table 8 and Table 9. Table 8 contains those factors that can be associated with tangible savings, while Table 9 is restricted to those human relations factors that usually result in intangible benefits. The most striking aspect of these two tables is that while they have been separated by tangible benefits received, they also fall into this

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Table 7

Factors Deleted from Original Battery, because of Infrequent  
Appearance in Acceptable Beneficial Suggestions at NOPI

Rank	Factor Number	Factor	D-value
9	X <sub>7</sub>	Have movements been combined? . . . . .	.69
11	X <sub>4</sub>	Have countings been eliminated? . . . . .	.44
12	X <sub>8</sub>	Have delays been combined? . . . . .	.42
13	X <sub>21</sub>	Is Government property better protected? . . . .	.41
14	X <sub>20</sub>	Has housekeeping been improved? . . . . .	.40
17	X <sub>13</sub>	Have health hazards been reduced? . . . . .	.24
18	X <sub>10</sub>	Is more work accomplished during the machine cycle?	.24
21	X <sub>11</sub>	In group work, does one man hold up the work? . .	.00
22	X <sub>12</sub>	Have fire hazards been reduced? . . . . .	-.29



Table 8

Abridged Battery of Factors, Ranked by D-value, Containing

Factors Involving a Measurable Monetary Saving at NOPI

Rank	Factor Number	Factor	D-value	$r_t$
1	X <sub>22</sub>	Is there a measurable monetary saving? . . . . .	1.83	.84
2	X <sub>1</sub>	Has an operation been eliminated or made easier?	1.30	.66
3	X <sub>5</sub>	Have inspections been eliminated? . . . . .	1.04	.56
4	X <sub>18</sub>	Has quality been improved? . . . . .	1.00	.54
5	X <sub>2</sub>	Has a movement been eliminated or made easier? .	.90	.51
6	X <sub>17</sub>	Has material been conserved? . . . . .	.89	.50
7	X <sub>16</sub>	Has waste been reduced? . . . . .	.75	.41
8	X <sub>6</sub>	Have operations been combined? . . . . .	.70	.40
10	X <sub>3</sub>	Has a delay been eliminated or reduced? . . . . .	.63	.35
15	X <sub>9</sub>	Has machine time been reduced? . . . . .	.32	.20





Table 9  
Abridged Battery of Factors, Ranked by D-value, Containing  
Factors Pertaining to Human Relations at NOPI

Rank	Factor Number	Factor	D-value	$r_t$
16	X	Have working conditions been improved? . . . .	.28	.17
19	X	Has morale been boosted? . . . . .	.23	.12
20	X	Have accident hazards been reduced? . . . . .	.18	.10



very same grouping when ranked by D-value and/or coefficient of correlation. In other words, the three factors in Table 9 are the last three factors in Table 6.

As a brief summary, it is well to observe that a measurable monetary saving is the best single factor in a beneficial suggestion. On the other hand, considering only the factors that appear infrequently, those pertaining to human relations are at the end of the list.

As mentioned earlier, seldom do any of these factors appear alone. With this in mind, three parallel studies were made of various combinations of these factors. Table 10 is made up of a selected combination of factors taken from Table 6, page 25. Necessarily, the first factor here, measurable savings, is the same as in Table 6. However, if savings are accompanied by a human relations factor, improved working conditions, the coefficient of correlation increases from .84 to .94. If a third factor, reduced delays, is added to these two, the coefficient of correlation is increased slightly to .95. The determination of the best combination of these factors depends upon the inter-correlation of these factors with each other as well as with the criterion.

As a parallel to Table 8 and Table 9, corresponding tables involving a combination of tangible and intangible benefits have been prepared respectively. Table 11, made up of only tangible benefits, has a measurable saving as the first factor with a coefficient of correlation again of .84. When the factor, reduced delays, has been added, the coefficient jumps to .90. By adding another factor, conservation of materials, the coefficient is increased to .93. Table 12 picks up the three human relations factors. However, these three - working conditions plus safety plus morale - only raise the coefficient of correlation to .23.



Table 10

Correlation Obtained between Evaluation on Selected Factors  
and the Criterion for 391 Beneficial Suggestions at NOPI

Factor Added	Selected Items	$r_t$
$X_{22}$	Saving, measurable	.84
$X_{14}$	Saving plus work conditions	.94
$X_3$	Saving plus work conditions plus fewer delays	.95



Table 11

Correlation Obtained between Evaluation on Selected Factors  
of the Abridged Battery of Tangible Saving Factors, Table 8 ,  
and the Criterion for 391 Beneficial Suggestions at NOPI

Factor Added	Selected Items	$r_t$
$X_{22}$	Saving, measurable	.84
$X_3$	Saving plus fewer delays	.90
$X_{17}$	Saving plus fewer delays plus save material	.93





Table 12

Correlation Obtained between Evaluation on Selected Factors of the Abridged Battery of Human Relation Factors, Table 9 , and the Criterion for 391 Beneficial Suggestions at NOPI

Factor Added	Selected Items	$r_t$
X <sub>15</sub>	Working conditions	.17
X <sub>14</sub>	Working conditions plus safety	.21
X <sub>19</sub>	Working conditions plus safety plus morale	.23



A review of these tables indicates that a combination of tangible and intangible benefits results in the highest multiple correlation with the criterion. From a mathematical viewpoint, this is due to a low or negative inter-correlation between factors. Practically, it means the suggestion has diversified qualities.

The low multiple coefficient of correlation in Table 12 results from a relatively high inter-correlation between factors. From a physical standpoint, this means that each factor measures about the same thing but is designated by a different title.

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## U. S. Naval Ordnance Plant, Forest Park

The Naval Ordnance Plant, Forest Park, located in a western suburb of Chicago, Illinois, was originated by Congressional legislation at the outset of the wartime emergency which, in effect, authorized the Secretary of the Navy to provide additional ordnance manufacturing facilities and equipment for the Navy. This station was operated during World War II by a subsidiary of the American Can Company under a contract with the Navy Department for the production of torpedoes, torpedo parts, and assemblies. Shortly after the cessation of hostilities, the plant became part of the permanent Naval Establishment. Since conversion, the role of this establishment has been primarily, in contrast to its wartime production pace, the storage and modernization of torpedoes and the manufacture of new torpedoes, spare parts and tools. Likewise, the number of employees has been reduced from a wartime peak of approximately 6,500 to a present on-board count of approximately 1,300.

A study of 322 beneficial suggestions submitted between the middle of 1947 and February 1950 was made at this plant. Of these 322 suggestions, 142 were considered acceptable and 180 were rejected. A graphic portrayal of the NOP-PP data and its distribution are shown in Figure 3, page 51 in the Appendix.

After these beneficial suggestions were evaluated, the results were tabulated and put in a form similar to those of NOPPI. Thus the factors contained in Table 3, page 10, were separated into two lists containing those that did and did not appear more than 5 percent of the time in winning beneficial suggestions. This resulted in Tables 13 and 14 respectively. Similarly, Table 13 was further broken down into those factors associated with tangible benefits and those with intangible - human rela-

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1. The first of these is the fact that the Commission has not yet received any information from the Government of the United States regarding the results of its investigation of the activities of the American Friends Service Committee in the Philippines.

1. The first part of the report deals with the general situation of the country and the position of the various groups of the population. It is a very general and superficial treatment of the subject, but it is a good starting point for a more detailed study.

Table 13

Abridged Battery of Factors, Ranked by D-value, for 322 Beneficial  
Suggestions at NOP-FP

Rank	Factor Number	Factor	D-value	$r_t$
1	X <sub>22</sub>	Is there a measurable monetary saving? . . . .	2.51	.95
2	X <sub>23</sub>	Has a tool been suggested? . . . . .	.88	.49
3	X <sub>1</sub>	Has an operation been eliminated or made easier?	.87	.48
4	X <sub>18</sub>	Has quality been improved? . . . . .	.84	.47
5	X <sub>24</sub>	Has a jig or fixture been suggested? . . . .	.80	.46
6	X <sub>2</sub>	Has a movement been eliminated or made easier?	.80	.46
7	X <sub>9</sub>	Has machine time been reduced? . . . . .	.80	.44
8	X <sub>14</sub>	Have accident hazards been reduced? . . . .	.60	.35
9	X <sub>16</sub>	Has waste been reduced? . . . . .	.40	.30
10	X <sub>17</sub>	Has material been conserved? . . . . .	.22	.18
11	X <sub>3</sub>	Has a delay been eliminated or reduced? . . .	.11	.08
12	X <sub>20</sub>	Has housekeeping been improved? . . . . .	0	-.01
22	X <sub>15</sub>	Have working conditions been improved? . . .	-.22	-.16
24	X <sub>19</sub>	Has morale been boosted? . . . . .	-.46	-.24





Table 14

Factors Deleted from Original Battery, because of Infrequent Appearance  
in Acceptable Beneficial Suggestions at NOP-FP

Rank	Factor Number	Factor	D-value
13	X <sub>4</sub>	Have countings been eliminated? . . . . .	0
14	X <sub>5</sub>	Have inspections been eliminated? . . . . .	0
15	X <sub>7</sub>	Have movements been combined? . . . . .	0
16	X <sub>8</sub>	Have delays been combined? . . . . .	0
17	X <sub>10</sub>	Is more work accomplished during the machine cycle?	0
18	X <sub>11</sub>	In group work, does one man hold up the work? . .	0
19	X <sub>12</sub>	Have fire hazards been reduced? . . . . .	0
20	X <sub>6</sub>	Have operations been combined? . . . . .	--.17
21	X <sub>21</sub>	Is Government property better protected? . . . . .	--.20
23	X <sub>13</sub>	Have health hazards been reduced? . . . . .	--.40



tions- benefits. This resulted in Tables 15 and 16 on pages 39 and 40 respectively.

Since these tables and the rank order of the factors therein parallel the study at NCPI, the reader is urged to refer to pages 24 through 30 for additional discussion and explanation of these tables.

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Table 15

Abridged Battery of Factors, Ranked by D-value, Containing Factors Involving  
a Measurable Monetary Saving for 322 Beneficial Suggestions at NOP-FP

Rank	Factor Number	Factor	D-value	$r_t$
1	X <sub>22</sub>	Is there a measurable monetary saving? . . . .	2.51	.95
2	X <sub>23</sub>	Has a tool been suggested? . . . . .	.88	.49
3	X <sub>1</sub>	Has an operation been eliminated or made easier?	.87	.48
4	X <sub>18</sub>	Has quality been improved? . . . . .	.84	.47
5	X <sub>24</sub>	Has a jig or fixture been suggested? . . . . .	.80	.46
6	X <sub>2</sub>	Has a movement been eliminated or made easier?	.80	.46
7	X <sub>9</sub>	Has machine time been reduced? . . . . .	.80	.44
9	X <sub>16</sub>	Has waste been reduced? . . . . .	.40	.30
10	X <sub>17</sub>	Has material been conserved? . . . . .	.22	.18
11	X <sub>3</sub>	Has a delay been eliminated or reduced? . . . .	.11	.08



Table 16

Abridged Battery of Factors, Ranked by D-value, Containing Factors  
Pertaining to Human Relations for 322 Beneficial  
Suggestions at NOP-FP

Rank	Factor Number	Factor	D-value	$r_t$
8	X <sub>14</sub>	Have accident hazards been reduced? . . . . .	.60	.35
12	X <sub>20</sub>	Has housekeeping been improved? . . . . .	0	-.01
22	X <sub>15</sub>	Have working conditions been improved? . . . . .	-.22	-.16
24	X <sub>19</sub>	Has morale been boosted? . . . . .	-.46	-.24





## U. S. Naval Ammunition Depot, Crane

The U. S. Naval Ammunition Depot, Crane, commissioned on 1 December 1941, is the largest activity of its kind in the Ninth Naval District and the largest in utilized facilities in the United States. Located in the south-central part of Indiana, it covers nearly 100 square miles and employs approximately 2,100 civilians.

Remarkable though it is for its size, NAD Crane is among the newest of its type of activity. Its remoteness from congested areas, its generally desirable location in terms of transportation and power facilities, and its hilly topography make it highly suitable for magazine construction.

The U. S. Naval Ammunition Depot, Crane, has been assigned the following mission: to manufacture, store, and overhaul ammunition, ammunition components, and material; and to supply these items to the fleets and other ordnance establishments. Although the huge storage facilities have accommodated at one time thousands of pounds of high explosives, smokeless powder, medium-sized bombs, and torpedoes, the manufacture and assembly of ammunition is fully as important as the storage.

In addition to the production and storage functions of NAD Crane, it also has a unique supply function. In addition to the task of procuring materials for local use, this department also is required to furnish "wholesale" lots of any of its 129,000 ordnance spares to other activities and to the fleet. This entails segregation, identifying, and preserving these thousands of parts.

At the present time, NAD Crane is in a reduced operational status with many of the ordnance plants laid up for preservation and others in a standby condition.



A study of 250 beneficial suggestions, submitted between January 1947 and February 1950, was also made at this activity. Of these 250 suggestions, 128 were considered acceptable and 122 were rejected. A graphic portrayal of the MAD Crane data and its distribution is shown in Figure 4, page 52 in the Appendix.

The evaluated suggestions were handled in exactly the same manner as those of NOPI and MCP-PP. Thus Tables 17, 18, 19 and 20 on pages 43, 44, 45, and 46 respectively group the factors by frequency of appearance, infrequency of appearance, monetary saving and human relations respectively. As previously mentioned, the reader is urged to refer to pages 24 through 30 which cover the general aspects of these tables.

While these tables are quite alike, it must be observed that Table 20 on page 46 is as twice as long as its shortest counterpart, Table 9 on page 29 for NOPI. This is undoubtedly due to major emphasis placed on safety at MAD Crane. This, of course, is due to the nature of the activity. While safety is being considered at every turn, it is bound to carry over to the more indirect phases such as housekeeping and the protection of property. These facts coupled with Crane's relative isolation from a major Indiana city contribute to this added interest in the human relations elements.

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1. The first part of the document is a list of names and their corresponding dates. The names are: "John Doe", "Jane Smith", "Bob Johnson", "Alice Brown", "Charlie White", "David Green", "Eve Black", "Frank Gray", "Grace Pink", "Henry Blue", "Ivy Yellow", "Jack Purple", "Karen Red", "Leo Orange", "Mia Silver", "Noah Gold", "Olivia Bronze", "Pete Copper", "Quinn Iron", "Rory Tin", "Sam Lead", "Tina Zinc", "Uma Nickel", "Victor Platinum", "Wendy Silver", "Xavier Gold", "Yara Bronze", "Zoe Copper". The dates are: "1990-01-01", "1990-02-01", "1990-03-01", "1990-04-01", "1990-05-01", "1990-06-01", "1990-07-01", "1990-08-01", "1990-09-01", "1990-10-01", "1990-11-01", "1990-12-01", "1991-01-01", "1991-02-01", "1991-03-01", "1991-04-01", "1991-05-01", "1991-06-01", "1991-07-01", "1991-08-01", "1991-09-01", "1991-10-01", "1991-11-01", "1991-12-01", "1992-01-01", "1992-02-01", "1992-03-01", "1992-04-01", "1992-05-01", "1992-06-01", "1992-07-01", "1992-08-01", "1992-09-01", "1992-10-01", "1992-11-01", "1992-12-01".

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1. The first step is to identify the problem or question that needs to be answered. This involves understanding the context and the specific information required.

Table 1. Summary of the results of the analysis of variance.

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1. The first step is to identify the problem or question that needs to be answered. This involves understanding the context and the specific requirements of the task.

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Table 17

Abridged Battery of Factors, Ranked by D-value, for 250 Beneficial  
Suggestions at NAD Crane

Rank	Factor Number	Factor	D-value	$r_t$
1	X22	Is there a measurable monetary saving? . . . .	2.60	.89
2	X23	Has a tool been suggested? . . . . .	1.12	.58
3	X18	Has quality been improved? . . . . .	1.02	.56
4	X1	Has an operation been eliminated or made easier?	.94	.55
5	X6	Have operations been combined? . . . . .	.90	.48
6	X2	Has a movement been eliminated or made easier?	.77	.44
7	X16	Has waste been reduced? . . . . .	.72	.43
8	X13	Have health hazards been reduced? . . . . .	.71	.42
9	X14	Have accident hazards been reduced? . . . . .	.69	.40
10	X24	Has a jig or fixture been suggested? . . . . .	.67	.37
11	X17	Has material been conserved? . . . . .	.46	.28
12	X8	Has a delay been eliminated or reduced? . . . .	.45	.26
13	X20	Has housekeeping been improved? . . . . .	.40	.24
14	X19	Has morale been boosted? . . . . .	.39	.22
17	X15	Have working conditions been improved? . . . .	.30	.19
19	X21	Is Government property better protected? . . . .	.10	.06



Table 18

Factors Deleted from Original Battery, because of Infrequent Appearance in  
Acceptable Beneficial Suggestions at NAD Crane

Rank	Factor Number	Factor	D-value
15	X <sub>7</sub>	Have movements been combined? . . . . .	.30
16	X <sub>9</sub>	Has machine time been reduced? . . . . .	.30
18	X <sub>10</sub>	Is more work accomplished during the machine cycle?	.10
20	X <sub>8</sub>	Have delays been combined? . . . . .	.10
21	X <sub>5</sub>	Have inspections been eliminated? . . . . .	0
22	X <sub>11</sub>	In group work, does one man hold up the work? . .	0
23	X <sub>12</sub>	Have fire hazards been reduced? . . . . .	0
24	X <sub>4</sub>	Have countings been eliminated? . . . . .	0





Table 19

Abridged Battery of Factors, Ranked by D-value, Containing Factors Involving  
a Measurable Monetary Saving for 250 Beneficial Suggestions at NAD Crane

Rank	Factor Number	Factor	D-value	$r_t$
1	X <sub>22</sub>	Is there a measurable monetary saving? . . . .	2.60	.89
2	X <sub>23</sub>	Has a tool been suggested? . . . . .	1.12	.58
3	X <sub>18</sub>	Has quality been improved? . . . . .	1.02	.56
4	X <sub>1</sub>	Has an operation been eliminated or made easier?	.94	.55
5	X <sub>6</sub>	Have operations been combined? . . . . .	.90	.48
6	X <sub>2</sub>	Has a movement been eliminated or made easier?	.77	.44
7	X <sub>16</sub>	Has waste been reduced? . . . . .	.72	.43
10	X <sub>24</sub>	Has a jig or fixture been suggested? . . . . .	.67	.37
11	X <sub>17</sub>	Has material been conserved? . . . . .	.46	.28
12	X <sub>3</sub>	Has a delay been eliminated or reduced? . . . .	.45	.26



Table 20

Abridged Battery of Factors, Ranked by D-value, Containing Factors  
Pertaining to Human Relations for 250 Beneficial  
Suggestions at NAD Crane

Rank	Factor Number	Factor	D-value	$r_4$
8	X <sub>13</sub>	Have health hazards been reduced? . . . . .	.71	.42
9	X <sub>14</sub>	Have accident Hazards been reduced? . . . . .	.69	.40
13	X <sub>20</sub>	Has housekeeping been improved? . . . . .	.40	.24
14	X <sub>19</sub>	Has morale been boosted? . . . . .	.39	.22
17	X <sub>15</sub>	Have working conditions been improved? . . . . .	.30	.19
19	X <sub>21</sub>	Is Government property better protected? . . . . .	.10	.06



## CONCLUSION

One of the most interesting features of this study has been the general similarity of the end results. Most significant, and the factor ranked first by every activity, is the measurable monetary saving - tangible benefit. All too frequently it is assumed that activities such as those discussed above operate without due regard to cost. Yet, after evaluating 963 beneficial suggestions in three widely separated plants, the single most important factor is saving money.

As previously mentioned, this factor is never alone; it is supported by one or more of the others. While the supporting factor or factors cannot be singled out by name, it appears, in general, to be something associated with the employee's job and at a level he can cope with. This is borne out by the factors contained in Tables 8, 15, and 19 on pages 28, 39, and 45 respectively.

As would be expected, the previously mentioned fine-grained factors, appearing in Tables 7, 14, and 18 on pages 27, 37, and 44 respectively were not caught in the mesh of this investigation. Possibly they were not present. After all, such fine points as combining movements, combining delays, etc., are expected to be beyond the reasonable capabilities of the usual operator and fall within the sphere of management or methods engineering.

Another group of factors in this category would be those pertaining to human relations, Tables 9, 16, and 20 on pages 29, 40, and 46 respectively. In broad terms, factors such as morale and working conditions, which by definition encompass workers as a group rather than as individuals, are also beyond the usual scope of the operator and fall within the domain of management.

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As a specific example, let us consider safety at MAD Crane. While this item receives preferential consideration, few of the suggestions were related to what one would consider the prevention of major disasters for an activity of that kind; the majority of Crane's suggestions were, in reality, the kind to be expected in any manufacturing establishment. After a little thought, this is what one would expect. MAD Crane was designed and built by experts and technicians in the field of explosives. How what possibility has the usual employee with only a farming background of coming up with an acceptable suggestion of this type? If conditions were present for him to accomplish this, he probably would not live long enough to reach for a pencil!

Thus it seems clear that an employee's best chance of submitting a winning beneficial suggestion, yet containing a minimum number of factors, is to:

1. Improve his own job, the one he is familiar with.
2. Save the activity money in a way that can be measured with reasonable ease.
3. Avoid the fine-grained factors that - while measurable - only show savings in mass production or continuous manufacture.
4. Avoid the human relations factors - they belong to management.

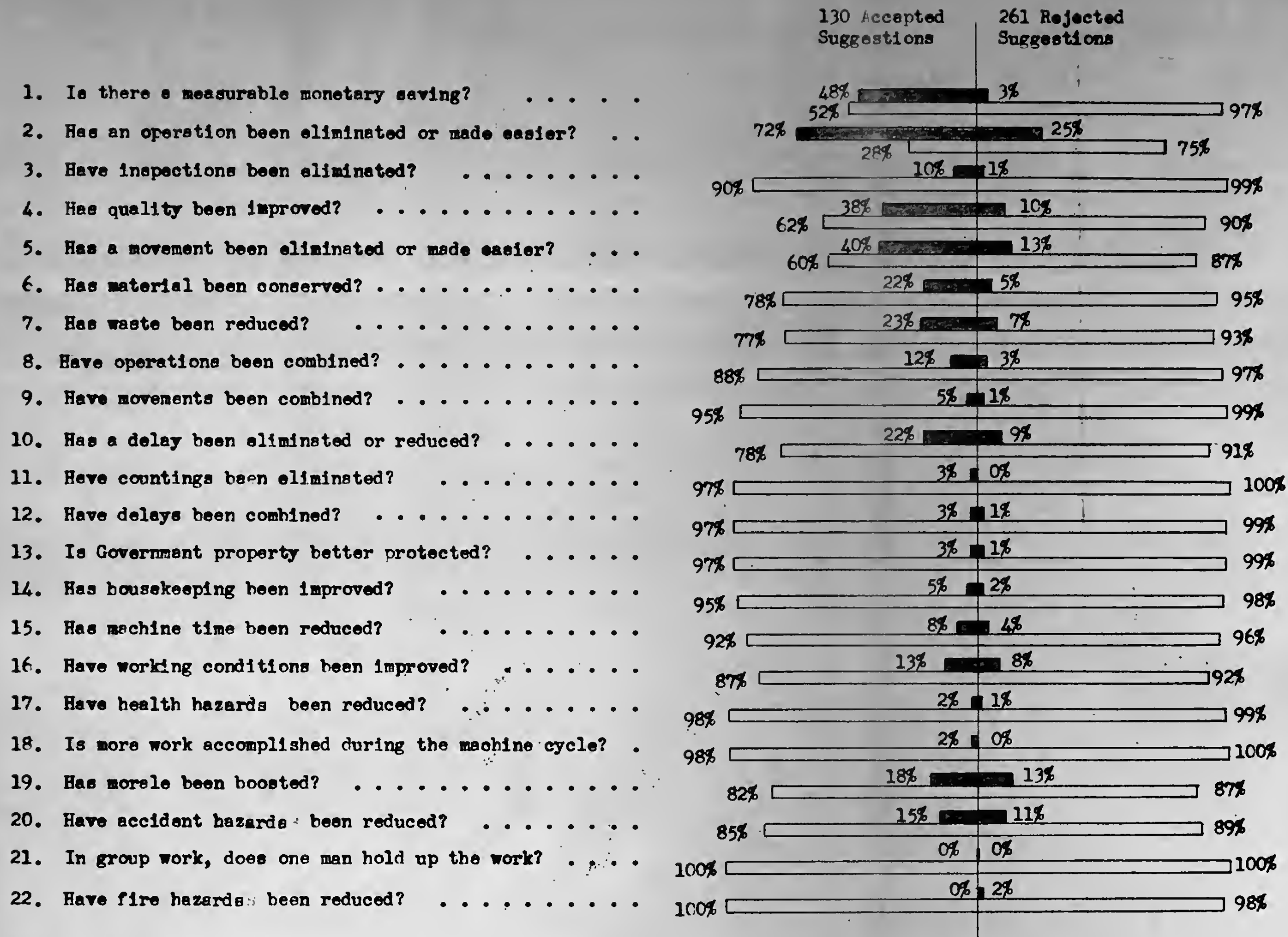
However, as mentioned on page 34, when several factors are employed, a combination of both tangible and intangible items results in the highest correlation with the criterion - winning.





## APPENDIX





Percentage of factor applicable.

Percentage of factor not applicable

Fig.2 The percentage of suggestions possessing and not possessing various factors at NOPI.



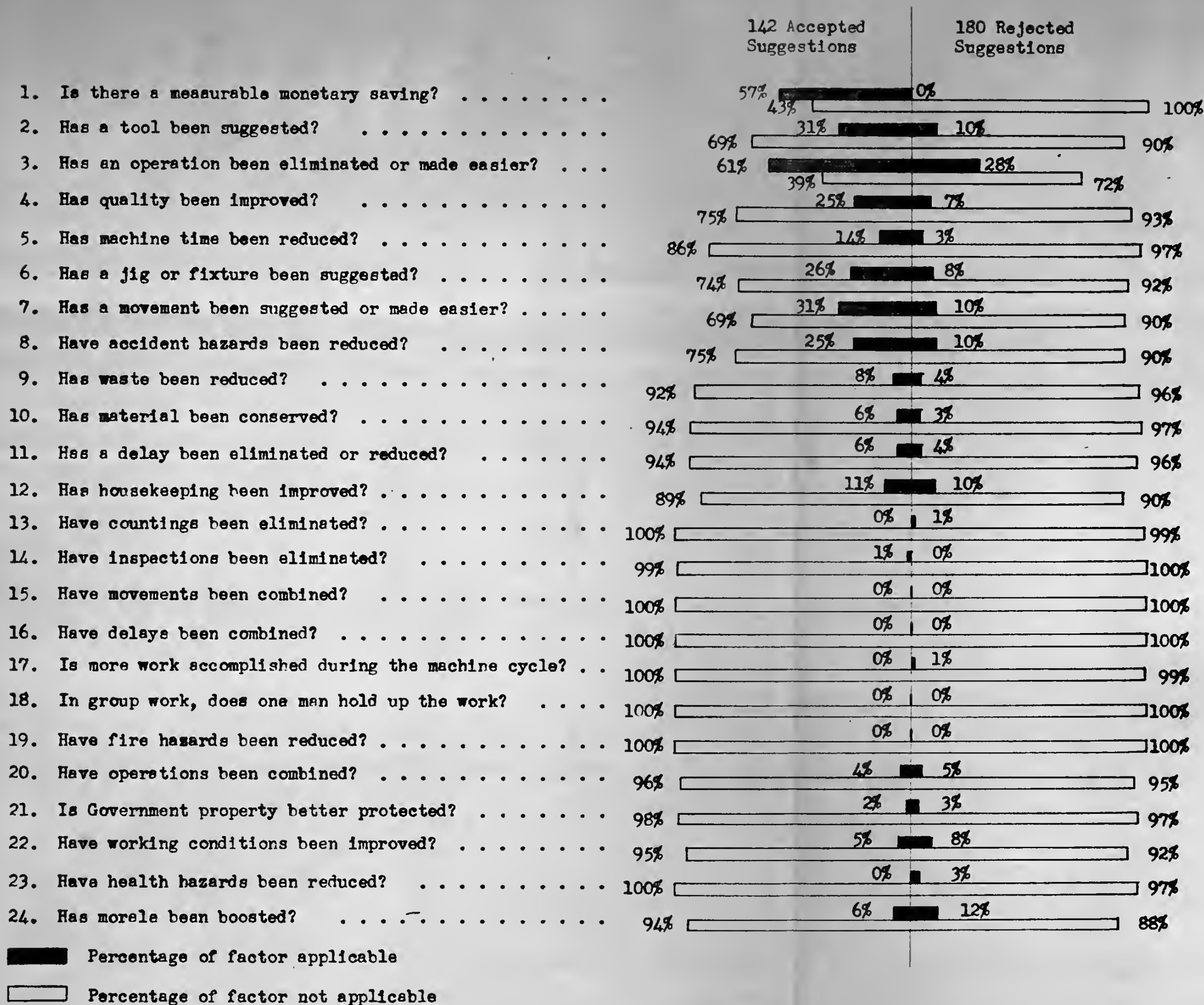


Fig. 3 The percentage of suggestions possessing and not possessing various factors at NOP-FP



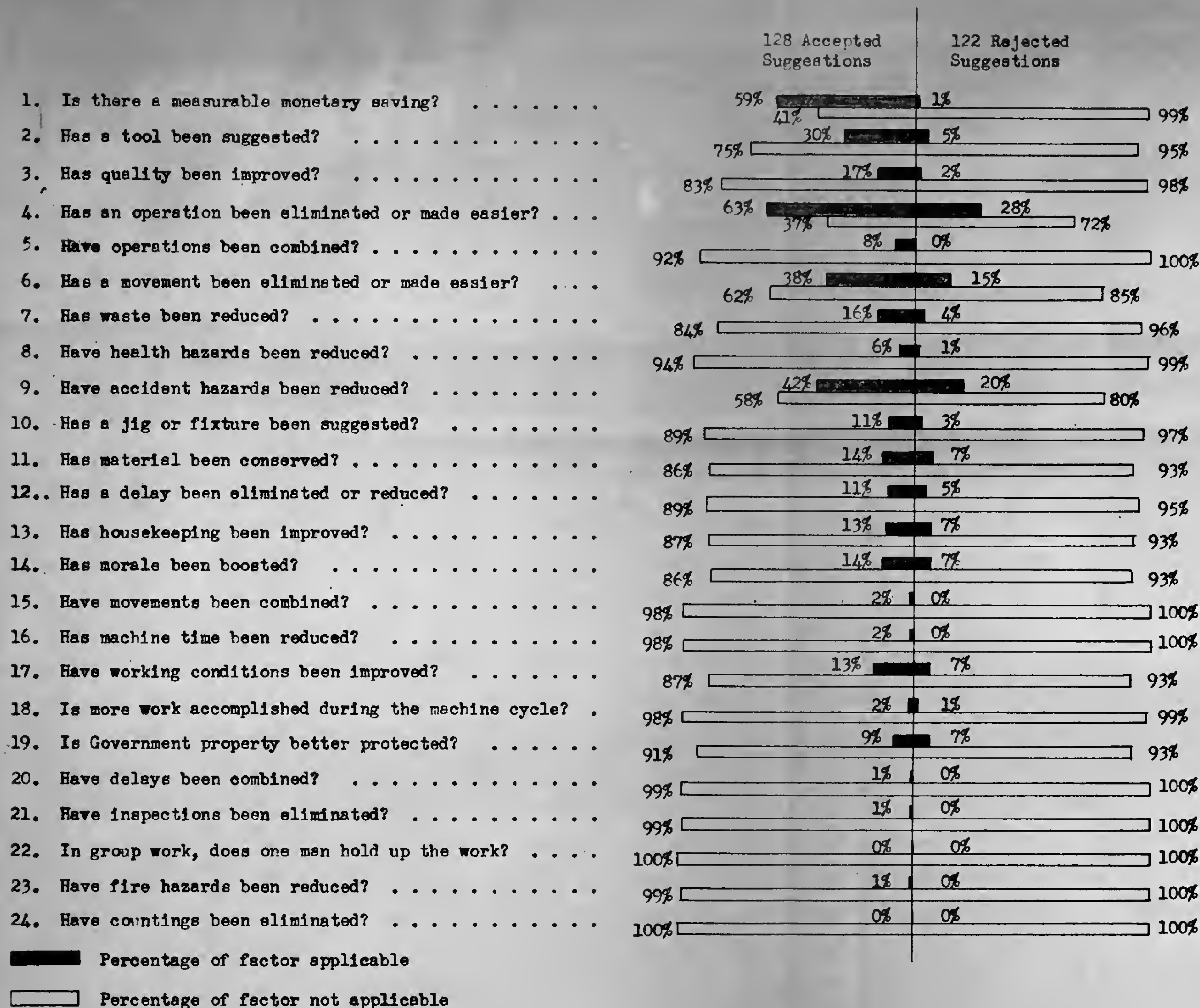


Fig. 4 The percentage of suggestions possessing and not possessing various factors at NAD Crane





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Humphreys

An analysis of the factors t-  
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